

GEOLOGY AND MAGNETIC
PROPERTIES OF AN ULTRABASIC
BODY AT TOWER PEAK, YUKON
TERRITORY

BY
JOHN M. HAMILTON

POLAR
PAM
1692

POLARPAM

921 Beckwith Road,
Richmond, B.C.,
April 9th, 1965.

Dr. W. H. Mathews,
Head, Geology Department,
University of British Columbia,
Vancouver 8, B.C.

Dear Sir:

I hereby submit my graduating essay
entitled "Geology and Magnetic Properties of an Ultrabasic Body
at Tower Peak, Yukon Territory", in partial fulfillment of the
requirements for the B. A. Sc. degree in Geological Engineering.

Yours truly,

John M. Hamilton

John M. Hamilton

U. B. C.
GEOLOGY LIBRARY

Rec'd: 19 Mar 1985
Order No.1
Price: 11L - photocopy
Acc. No.: UBC

BOREAL INSTITUTE
LIBRARY

GEOLOGY AND MAGNETIC PROPERTIES
OF AN ULTRABASIC BODY AT TOWER PEAK,
YUKON TERRITORY

by

John M. Hamilton

A thesis submitted in partial fulfillment
of the requirements for the degree of

Bachelor of Applied Science

in

Geological Engineering

THE UNIVERSITY OF BRITISH COLUMBIA

April 9th, 1965

U. B. C.
GEOLOGY LIBRARY

TABLE OF CONTENTS

	Page
ABSTRACT	
CHAPTER I INTRODUCTION	1
Location and Accessibility	1
Climate and Vegetation	3
Topography	4
Previous Development of Property	6
Acknowledgements	7
CHAPTER II GEOLOGY	8
Sedimentary and Volcanic Rocks	9
Ultrabasic Rocks	12
General Description	12
Alteration of Pyroxenite	14
Petrography of Serpentinities	15
Asbestos	18
Alteration of Sedimentary and Volcanic Rocks	19
Slate	19
Greenstone	20
"White Rocks"	22
CHAPTER III MAGNETIC PROPERTIES	27
General Statement	27

TABLE OF CONTENTS (CONT'D)

	Page
Airborne Magnetic Data	28
Ground Magnetic Data	29
Interpretation of Magnetic Data	31
CHAPTER IV GEOLOGIC HISTORY	33
CHAPTER V CONCLUSIONS	36
BIBLIOGRAPHY	38
APPENDIX I THE FLUXGATE MAGNETOMETER	40
APPENDIX II EFFECT OF CHANGE IN FLYING HEIGHT ON MAGNETIC DATA	43

LIST OF ILLUSTRATIONS

Figure	Page
1. Location Map of Tower Peak	2
2. Power-Wagon on Bulldozer Road	3
3. Looking Southwest Across Fish Creek	4
4. Looking Northwest Across Fish Creek	5
5. Looking North Along the East Side of Fish Creek	5
6. Photomicrograph of Sheared Mudstone (Plane Polarized Light)	10
7. Photomicrograph of Sheared Mudstone (Crossed Nicols)	10
8. Distribution of Ultrabasic Bodies in Western North America	13
9. Serpentine in Bulldozer Trench	15
10. Photomicrograph of Partly Serpentinized Pyroxenite (Plane Polarized Light)	16
11. Photomicrograph of Serpentine (Plane Polarized Light)	17
12. Photomicrograph of Serpentine (Crossed Nicols).	17
13. Weathered Surface of Carbonatized Greenstone	20
14. Sharpe MF-1 Fluxgate Magnetometer	30
15. Schematic Diagram of Fluxgate Magnetometer Sensor	41
16. Calculation of $\frac{\partial V}{\partial x}$ for Thin Horizontal Magnetic Sheet	44

LIST OF PLATES

(In Pocket at End)

Plate No.

- | | |
|-----|---|
| I | Geological Survey of Canada, "Quiet Lake Geology" |
| II | Geological Survey of Canada, "Mount St. Cyr
Airborne Magnetometer" |
| III | Tower Peak Topography and Geology |
| IV | Tower Peak Airborne Magnetometer |
| V | Tower Peak Ground Magnetometer |
| VI | Geological Survey of Canada, Flying Height Profiles |
| VII | Geological Sections and Magnetometer Profiles |

ABSTRACT

omit from stencil

Geological and ground magnetic data for this paper were gathered by the writer in June, 1964 while employed by the Consolidated Mining and Smelting Company of Canada Limited as a student assistant. Laboratory work was done during the 1964-65 university term.

The Tower Peak ultrabasic body appears to have intruded Lower Mississippian sediments concordantly as a relatively cool crystal mush. Hydrothermal solutions originating in granitic intrusions partly serpentinized the ultrabasics in Cretaceous time.

White rock bodies (rodingites) similar to those found in ultrabasics at other localities were probably emplaced as dykes before serpentinization occurred.

Economic deposits of chrysotile asbestos were not formed because (1) fracturing was not extensive and/or (2) hydrothermal activity was not sufficiently intense.

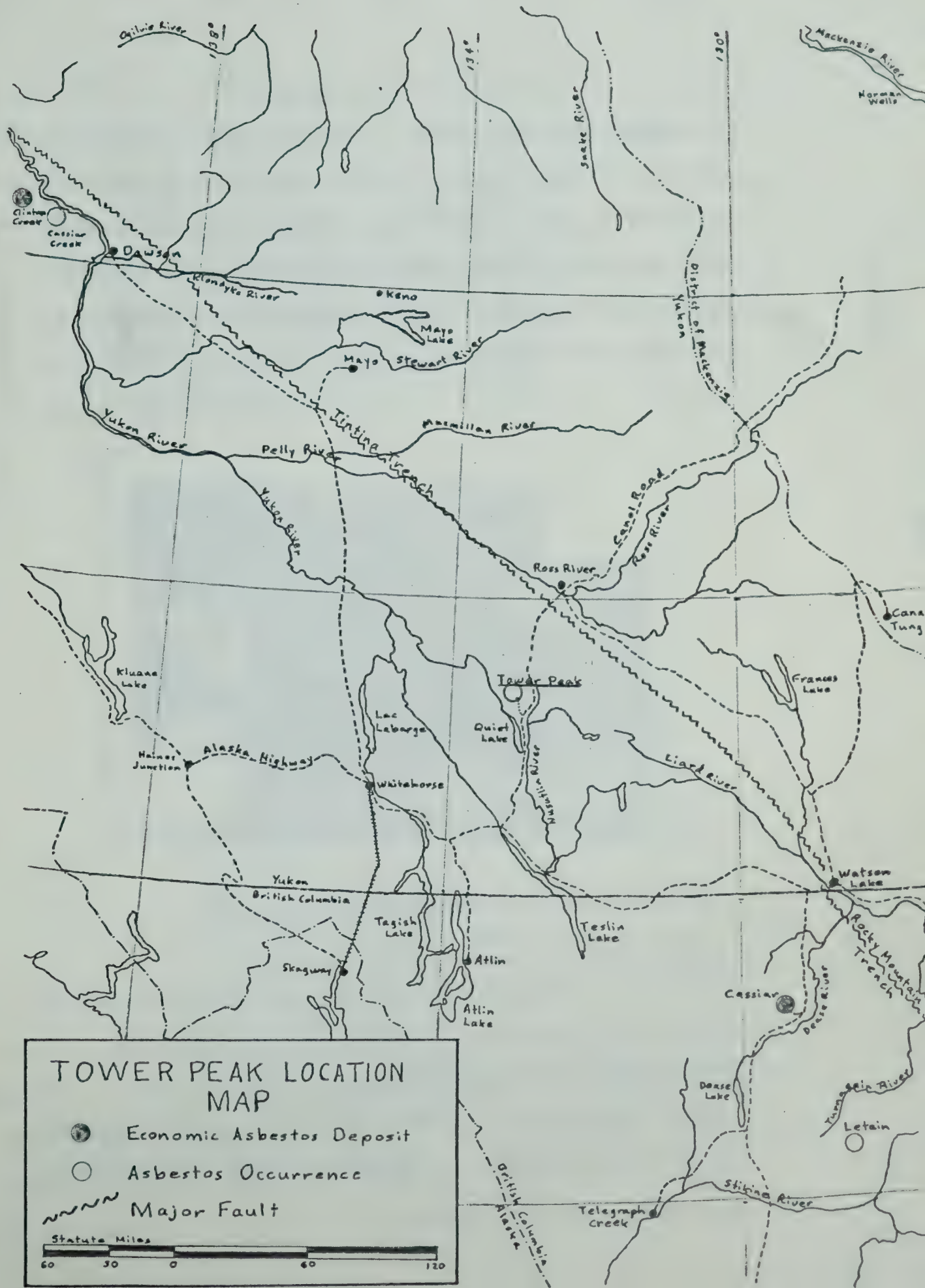
CHAPTER 1 INTRODUCTION

Field work for this thesis was done between May 30th and June 21st, 1964, while the writer was a member of a four-man party headed by R. G. Gifford of The Consolidated Mining and Smelting Company of Canada Limited.

An examination of the area was warranted for two reasons: regional geology is similar to that at the Cassiar Asbestos Mine, Cassiar, B.C.; and a high positive magnetic anomaly was found near Tower Peak when the Geological Survey of Canada did a reconnaissance airborne magnetic survey in 1961. Plate I and II (in pocket) are maps published by the G. S. C. showing regional geology and airborne magnetometer survey results.

Location and Accessibility

The area studied is in the Whitehorse Mineral District five miles due west of mile post 70 of the Canol Road, Yukon Territories, latitude $61^{\circ} 16' N$, longitude $133^{\circ} 10' W$. Figure 1, page 2, shows the location of Tower Peak. This paper deals with ultrabasic rocks that outcrop on each side of Fish Creek, which flows south in a valley on the east side of Tower Peak.



Truck access to the property is possible only during the summer months. The Canol Road, which joins the Alaska Highway at mile post 837, provides good transportation to the area, and an eight-mile bulldozer road which starts at mile post 62.5 of the Canol Road extends to the property. In early spring a four-wheel~~drive~~ drive vehicle equipped with a winch is necessary on the bulldozer road.



Fig.2 Power-Wagon on Bulldozer Road

Climate and Vegetation

Weather records are kept at Whitehorse, 80 miles to the southwest. Average yearly precipitation is 6.3 in. rain and 43.7 in. snow, or about 10.7 in. total water. Average yearly temperature is 31.1° F; average monthly temperatures are 5.2° F in January and 56.2° F in July. Snow covers the ground from October to May.

Vegetation in the Tower Peak area consists mainly of cedar and fir, although pine is abundant along ridges and in higher areas where soil is dry. Large stands of poplar grow south of the map-area. Poplar is more abundant in areas underlain by slate and greenstone. Thick underbrush occurs in small areas, but line-cutting was not necessary for chain and compass traverses with the magnetometer. Timberline is at an altitude of 5,000 feet.

Topography



Fig. 3 Looking Southwest Across Fish Creek

Highest magnetometer readings were obtained in this area. Trenching done in 1963 is visible at right of photograph.

Figures 3, 4 and 5 show the rolling topography of the map-area. Plate III (in pocket) is a topographic map compiled from aerial photographs. Fish Creek and other



Fig. 4 Looking Northwest Across Fish Creek

Tower Peak is visible at top left of photograph.

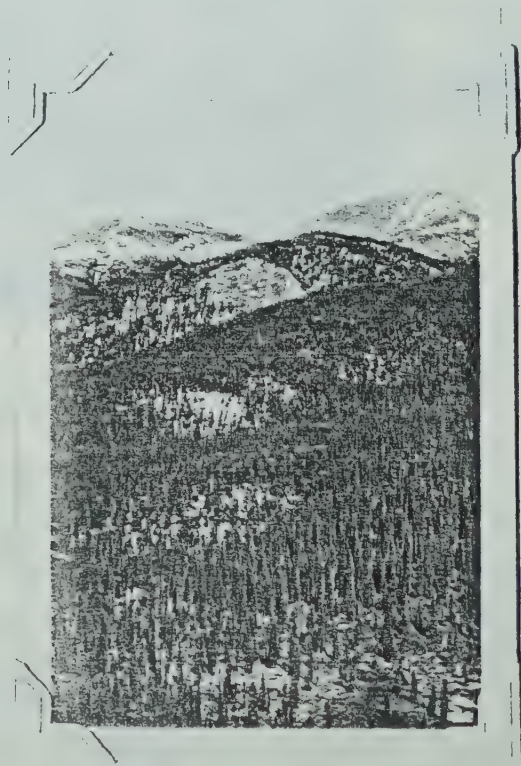


Fig. 5 Looking North Along the East Side of Fish Creek

Bluffs in middle- and fore-ground are composed of serpentized ultrabasic rock.

water-courses to the east flow south, whereas Big Salmon River in the valley to the west of the peak flows north, into the Yukon River.

This area has been glaciated. Despite gentle slopes small outcrops are fairly numerous, and glacial drift is nowhere very thick. Valleys are U-shaped, and most mountain tops are rounded. Numerous channels cut across ridge tops. These were probably formed by run-off streams as large blocks of ice melted. The soil layer is so thin in some places that asbestos fibre can be seen in the roots of overturned trees.

Previous Development of Property

Records kept by the Resident Geologist and Mining Recorder in Whitehorse show that some previous development work was done in this area. Forty claims were staked by five prospectors in August, 1954, and one year's development work recorded. Subsequently the claims were optioned to Bell Asbestos Corporation which staked an additional 200 claims in March, 1955. These claims covered the north and west sides of Tower Peak. Bell Asbestos built the bulldozer road and did some stripping on the north and west sides of Tower Peak. Some diamond drilling was done on the north side of Tower Peak, although no technical reports

were filed in the Mining Recorder's office by the company, and the claims fell open in 1956.

Eight claims staked on the east side of Fish Creek about two miles east of Tower Peak by H. Sarge in 1962 were optioned to Canex Aerial Exploration Limited which did some bulldozer stripping and ground magnetic surveying in September, 1963. These claims were then optioned to The Consolidated Mining and Smelting Company, which staked an additional 18 claims in the area late in 1963. At time of writing mineral rights to this area are owned by C. M. & S.

Acknowledgements

The writer wishes to express sincere thanks to The Consolidated Mining and Smelting Company Limited for allowing this investigation to be made. The helpful ideas and suggestions given by R. G. Gifford, Exploration Geologist, are also greatly appreciated. Members of the G. S. C. in Whitehorse, Vancouver and Ottawa provided helpful information through personal correspondence.

CHAPTER II GEOLOGY

E. D. Kindle (1946) of the G. S. C. geologically mapped the Canol Road in 1944 and 1945. J. O. Wheeler, L. H. Green and J. A. Roddick of the G. S. C. mapped the Quiet Lake area between 1956 and 1959. (G. S. C. Map 7-1960) (See Plate I).

Intrusions and metamorphic rocks have a north-northwest trend, common throughout the Western Cordillera. Folds, faults, and present drainage systems have a similar trend. Ultrabasic bodies outcrop along a northwest-trending line which roughly bisects the intrusive rocks. Commonly ultrabasics occur in pre-Mesozoic sediments, flanked by Mesozoic intrusions.

In the area dealt with in this paper, serpentized ultrabasic rocks occur between slates and greenstones of late Devonian or early Mississippian age, apparently as concordant intrusions. It has been suggested (J. O. Wheeler, personal communication) that these slates and greenstones correlate with the Sylvester Group of the McDame area described by H. Gabrielse (1963). Thus, the Tower Peak ultrabasic body may occupy a stratigraphic position similar to that of the ultrabasic body at the Cassiar Asbestos Mine.

Sedimentary and Volcanic Rocks

Principal rocks in the Tower Peak area are slate and greenstone of Devonian or Mississippian age, which have a general dip to the northeast (see Plate III). East of the ultrabasic body slate and greenstone are interbedded whereas to the west slate predominates.

The slate is thin bedded, brown or black in colour. In general the beds are undeformed, but closed folds occur locally. Slaty cleavage parallels bedding. Fracture cleavage spaced at six-inch intervals is normal to bedding. If this is, in point of fact, axial plane cleavage it would imply a broad anticline trending north-north east.

A peculiar rock that outcrops immediately east of the serpentinite is composed of lenticular fragments of greenstone up to 1/4 inch long together with fragments of sandstone set in a very fine-grained (mud) matrix. Evidently, this rock was originally a mudstone or siltstone which was well indurated and subsequently sheared. Being interbedded with greenstone, evidently it was deposited between epochs of volcanic activity. A volcanic source for this rock is indicated by its greenstone fragments.

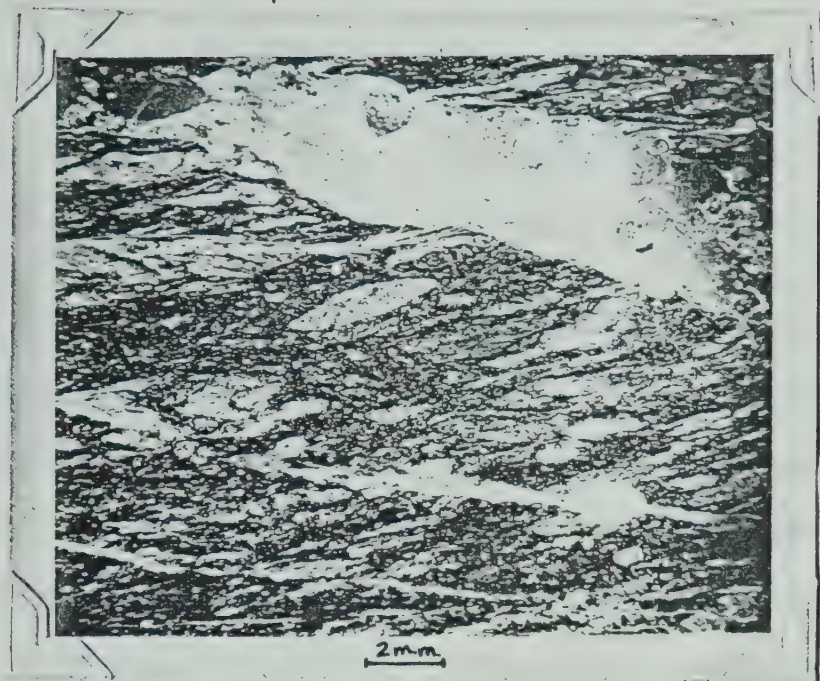


Fig. 6 Photomicrograph of Sheared Mudstone (Plane Polarized Light)

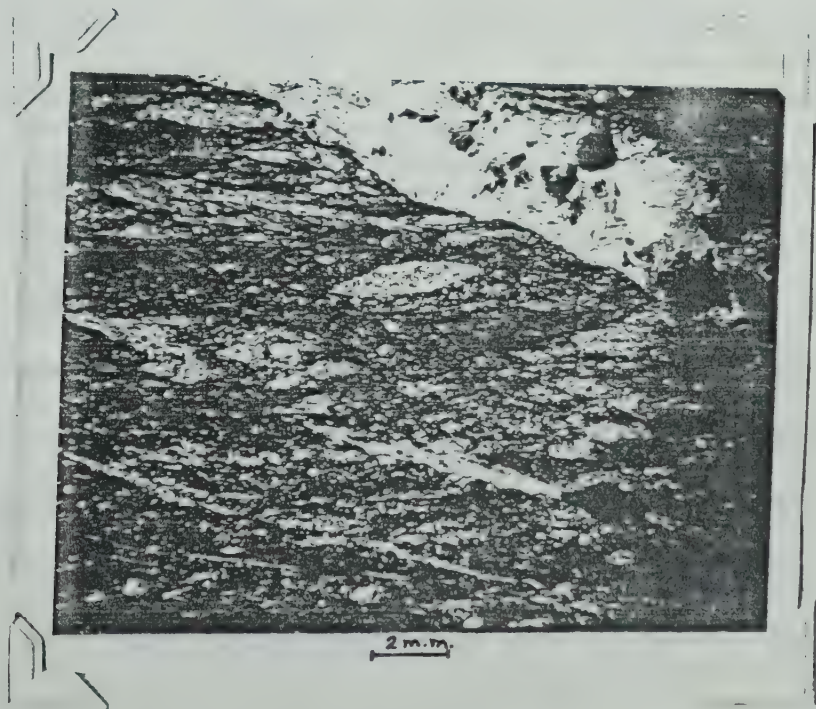


Fig. 7 Photomicrograph of Sheared Mudstone (Crossed Nicols)

Figures 6 and 7, page 10, are photomicrographs of this rock. Veinlets are of quartz-calcite. The rock contains a few small aggregates of prehnite with characteristic "bow tie" structure.

Greenstone flows, at least 400 ft. thick in the eastern part of the map-area, show no pillow structure, ropey tops nor columnar jointing. In the southeastern part of the map-area greenstone and slate are interbedded. Along the western edge of the map-area greenstone contains pipe vesicles and pumice.

A thin section of greenstone is composed of fine-grained turbid feldspars of composition An_{30} which shows a characteristic crystalloblastic texture. Feldspar grain boundaries are irregular or sutured. Some remnant olivine and pyroxene crystals indicate that this rock was originally an olivine basalt. Spherical vesicles are filled with calcite, some quartz and an opaque mineral (perhaps magnetite). Feldspar laths tend to encircle these vesicles. The greenstone section is about 25% opaque material which is white in reflected light, it is probably fine-grained argillitic material. Some chlorite and clinozoisite have developed interstitially.

Ultrabasic Rocks

General Description

Figure 8, page 13, shows the distribution of ultrabasic bodies in Western North America (Noble and Taylor, 1960, page 189). An ultrabasic belt splits into eastern and western chains at the 49th parallel. Noble and Taylor state that mineralogically zoned cylindrical bodies are common in the western chain and rare in the eastern chain. Bodies of the eastern type are elongated, often in a north-northwest direction, and serpentization is extensive or complete. They conclude that the chains came from separate magmas which differentiated deep in the earth's crust. The Tower Peak body appears to be typical of the eastern type. It occurs in a highly sheared area, where country rocks are mylonitized.

The original rock composing the Tower Peak body was pyroxenite which, except in its northern part, has been partly or completely serpentized. Fresh ultrabasic is greenish grey and massive. Weathered surfaces are mottled because pyroxene grains resist weathering, and reddish in colour due to formation of limonite. In thin section it has a fine to medium-grained allotriomorphic texture. The rock is 90% augite which occurs in anhedral grains, and 5% relict

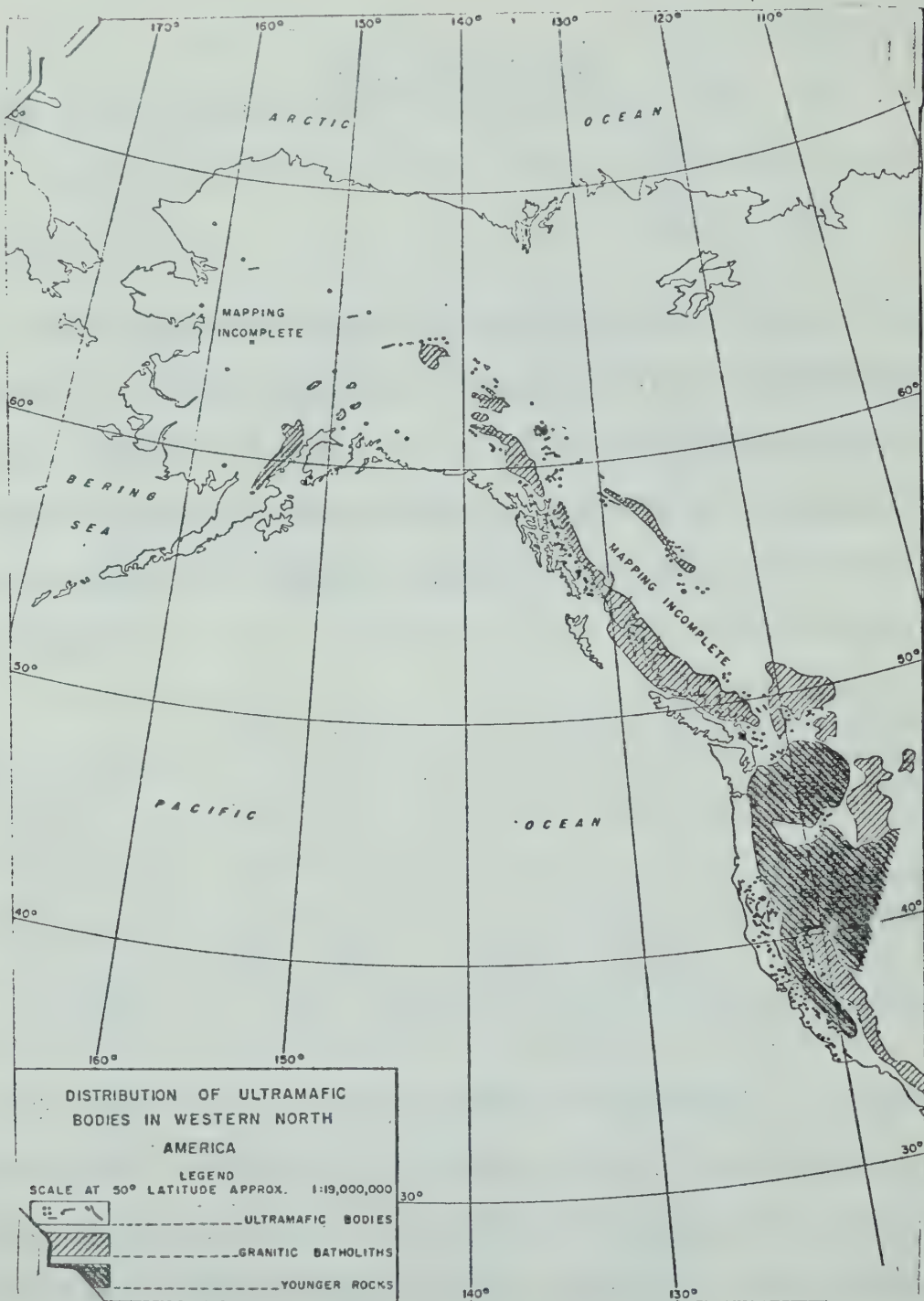


Fig. 8 Distribution of Ultrabasic Bodies in Western
North America

Source ?

plagioclase crystals. Interstitial blebs of magnetite form 2% of the rock.

No mineralogic zoning was noted in fresh pyroxenite. However, as no chrysotile has developed in fresh pyroxenite the north part of the map area was not studied in detail. No layers rich in any constituent were found in outcrops studies, and rock at different outcrops is identical in megascopic characteristics.

Alteration of Pyroxenite

Much of the Tower Peak pyroxenite body has been partly or completely serpentized, and in places asbestos has formed. Partly serpentized rock is about 60% antigorite, with 20% feldspar and 10% augite. Feldspars are greenish grey in colour. They weather white against the dark green antigorite, so their euhedral form is emphasized.

This rock may be a serpentized greenstone. It was observed at three small localities in the field, in the vicinity of greenstone. However, as this rock has less plagioclase and more magnetite than greenstone, it is more likely partly serpentized pyroxenite.

Completely serpentized pyroxenite is light to dark green on fresh surfaces, and brown on weathered outcrops. It has many slickensided surfaces. Figure 9, page 15, shows light green highly fractured serpentinite in a bulldozer trench.

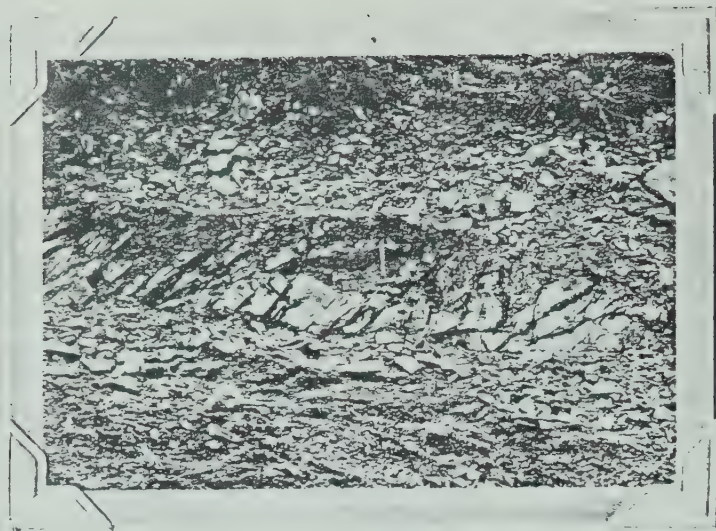


Fig. 9 Serpentinite in Bulldozer Trench

Petrography of Serpentinities

Pyroxene grains in fresh pyroxenite are partly altered to chlorite and epidote along grain boundaries. Veinlets of a very fine-grained low birefringent mineral (chlorite or antigorite) cut across grains. Plagioclase crystals have been partly replaced by chlorite and a fine-grained isotropic mineral.

Figure 10, page 16, is a photomicrograph of partly serpentinized pyroxenite. Relict feldspar crystals are altered almost entirely to antigorite. Relict albite twinning in one grain suggests that this feldspar is plagioclase. Fine-grained opaque argillitic material which is white in reflected light is also present in the feldspars, so they appear semi-opaque in Figure 10. This rock contains about 5% magnetite, as irregular blebs and a few veinlets.

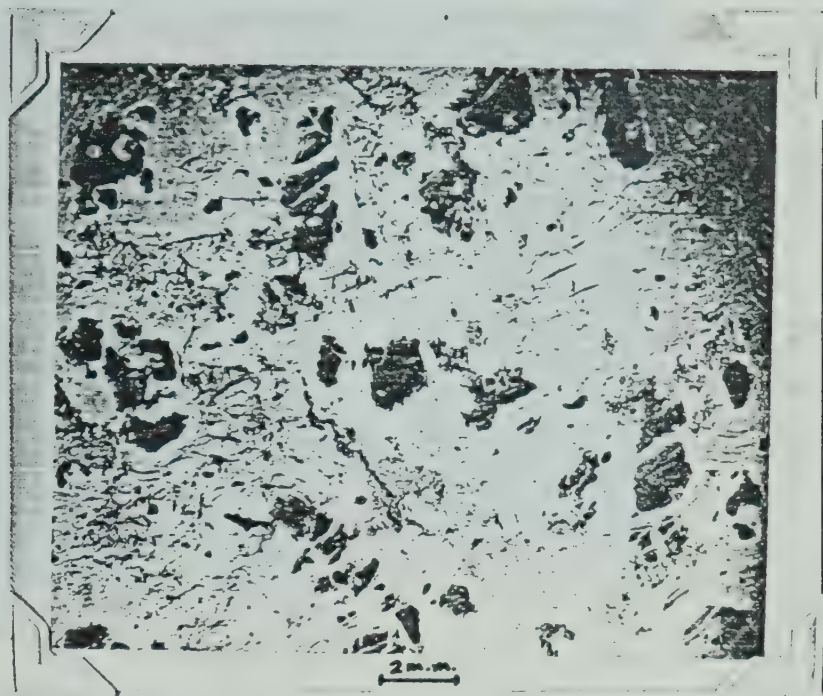


Fig. 10 Photomicrograph of Partly Serpentinized Pyroxenite
(Plane Polarized Light)

Figures 11 and 12, page 17, are photomicrographs of completely serpentinized pyroxenite. The thin section photographed was made from a specimen taken near the southernmost magnetometer anomaly (Plate V in pocket). Under crossed nicols, narrow veinlets of chrysotile appear parallel to magnetite seams. Chrysotile veinlets are mainly the "two-fibre" variety. It has been suggested that these veins form when vein walls move apart faster than vein-forming material can diffuse into the opening. Chrysotile fibres grow into the vein (toward the zone of least pressure) from each side, and magnetite is concentrated along the centre of the vein. The rock contains about 7% magnetite, most of which is in seams. Magnetite content in these ultrabasics increases with increasing serpentinization.

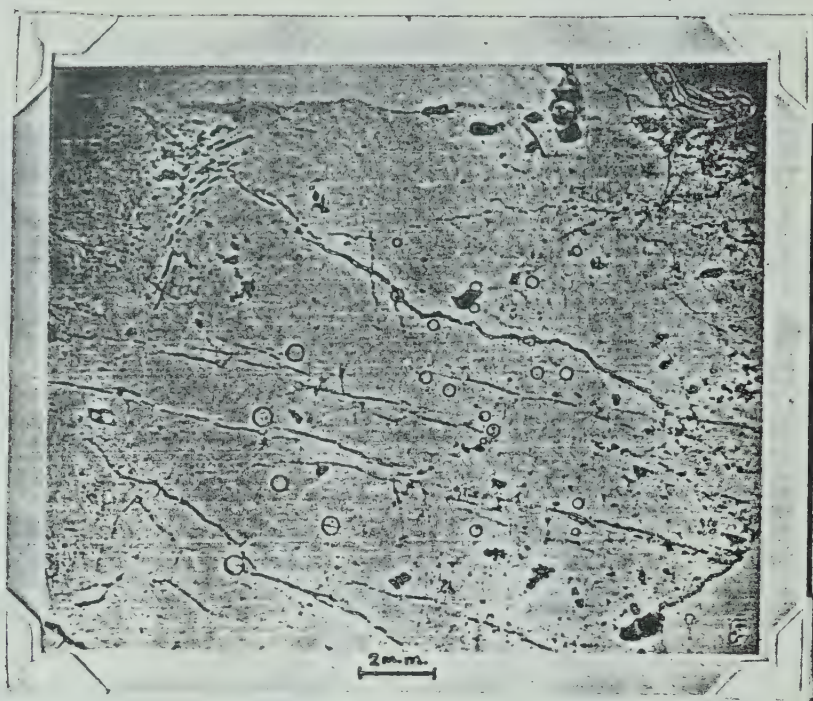


Fig. 11 Photomicrograph of Serpentinite (Plane Polarized Light)



Fig. 12 Photomicrograph of Serpentinite (Crossed Nicols)

This serpentinite contains 5% carbonate which fills elliptical and irregularly-shaped openings. Chrysotile veinlets cut the carbonate. Talc, a common mineral in serpentinites, was not observed.

Asbestos

Chrysotile is identified mainly by its asbestiform occurrence and megascopic properties. In thin section, some fibres are length-fast, and others are length-slow, although Kerr (1959) states that chrysotile and antigorite fibres are length-slow. As Nassichuk (1960, page 32) also observed this optical anomaly of serpentinites from the Quiet Lake area, perhaps length-fast chrysotile is peculiar to this area.

Chrysotile is found in most of the serpentinized rock. Generally fibres are normal to vein walls, most being less than 1/16 in. long. In areas of best fibre development about half the chrysotile is cross-fibre and the rest is slip-fibre. Columnar light green brittle material (picrolite) also forms slip-fibre veinlets.

Chrysotile is developed from antigorite by recrystallization of the silicate structure in an environment of low temperature and pressure. Hydrothermal fluids must be present. As most veins at Tower Peak are two-fibre veins, chrysotile probably grew into open fractures along which hydrothermal fluids moved. Slip-fibre veins appear to be due to post-chrysotile shearing because fibres in these veins are

ground together, and are not as strong in tension as normal fibres.

Alteration of Sedimentary and Volcanic Rocks

Slate

Slate near contacts with ultrabasics is sheared and locally tightly folded. Slate beds at the southern contact dip underneath ultrabasics at about 45° . Northern and eastern contacts are obscured by drift, but their position is indicated by magnetic data.

Slate near contacts is locally carbonatized. The carbonate is calcite. In thin section, relict shearing texture indicates shearing prior to carbonatization. This rock is about 5% quartz, which fills small vugs and forms veinlets in calcite.

Quartz and quartz-calcite veins from 1/4 in. to 1 in. wide cut slate beds at random attitudes. As these veins are not present more than 500 ft. from ultrabasics, they are probably related to emplacement of the ultrabasic body.

Greenstone

Greenstone at one outcrop about 50 ft. from ultrabasic rock has been highly altered to a slightly foliated "dioritic" rock. The complete sequence from ultrabasics to greenstones cannot be described because exposure at this locality is poor. A thin section of this rock showed it to be 60% tremolite, 30% plagioclase, with minor amounts of a colourless pyroxene (probably diopside), interstitial colourless chlorite (probably penninite), and sphene. The rock has a poikilitic texture with small feldspar laths and rounded pyroxene grains enclosed in tremolite. The ground-mass is fine-grained, sutured, turbid feldspar laths.

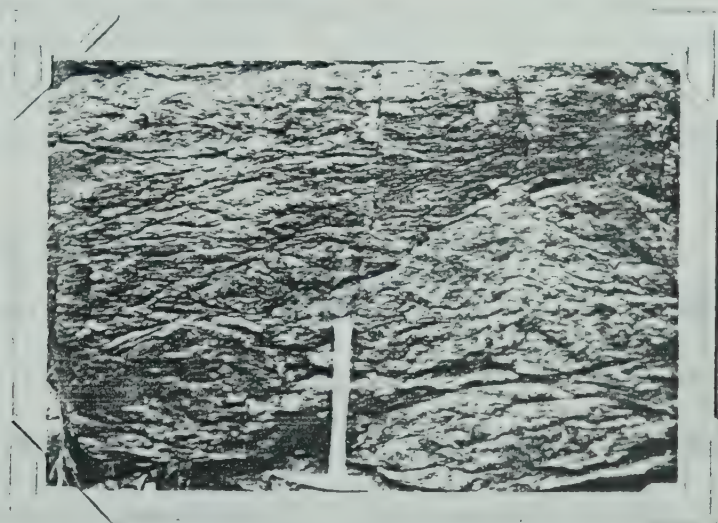


Fig.13 Weathered Surface of Carbonatized Greenstone

Greenstone near contacts with ultrabasic rock is locally carbonatized. Figure 13 shows the weathered surface of this rock, which is everywhere black or dark orange. Banding

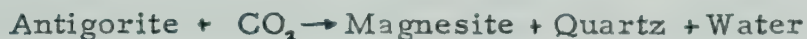
emphasized by differential weathering may be a relict flow structure, or may be caused by shearing. Local tight chevron folds and breccia indicate that these rocks have been strongly deformed, and it is more likely that the banding is caused by shearing prior to carbonatization.

Fresh surfaces of these rocks have all the megascopic characteristics of migmatites. Bands of light fine-grained material from $1/16$ in. to $3/4$ in. thick are separated by very thin dark bands.

Veins of quartz from $1/2$ in. to 3 in. wide cut the rock. Quartz crystals, $1/8$ in. to $1/2$ in. in diameter, grew perpendicular to vein walls and in many places open spaces remain between crystal terminations on each side of a vein. A few veins have later quartz crystals about $1/32$ in. diameter encrusting terminations of the earlier crystals.

The carbonate in this greenstone does not effervesce in cold hydrochloric acid (as does carbonatized shale) and carbonate stain tests are negative for calcite and dolomite. A fresh specimen shown by thin section to be 95% carbonate has a density of 2.97 gms/cm³. Density of pure magnesite is 3.00 gms/cm³. This evidence suggests that the mineral is magnesite.

Quartz and magnesite can be produced from alteration of antigorite according to this equation:



The carbon dioxide required for this reaction might have been present as an original constituent of the ultrabasic magma or it might have been a constituent of the hydrothermal solutions which caused serpentinization. The writer favours the latter idea because carbonate is found as secondary fillings in thin sections of serpentinite.

No original texture is visible in the thin section of carbonatized greenstone. Dark fine-grained material appears as very thin discontinuous stringers. About 2% of the slide is fine-grained quartz which fills vugs and forms discontinuous veinlets.

"White Rocks"

Tabular bodies of creamy white, medium to fine-grained rock of density 3.34 gms/cm were found in C.C. ultrabasics at three localities. At two localities these bodies

were completely enclosed by serpentinite. They were 3 ft. to 6 ft. wide and as much as 100 ft. long. A contact "reaction rim" from 1 in. to 3 in. wide appears in adjoining serpentinite. The width of this rim does not appear to bear any relation to the width of white rocks, although rims on either side of a white rock body are of equal width. These rims are aphanitic, black to dark reddish-brown, hard, tough and non-magnetic.

At one locality dykes of white rock cut partly serpentinitized ultrabasics. Seven roughly parallel dykes with moderate dips were observed in a 100-ft. horizontal distance. Dykes pinch and swell along dip from six inches to one foot wide. One dyke was displaced about two feet by a fault which did not displace adjacent dykes, and many dyke contacts were slickensided. Dyke rocks are generally more fine-grained near their margins.

Some white rocks have angular elongated openings filled by needle-like crystals. These crystals have hardness 7, vitreous to resinous lustre, and green colour. Oil emersion slides show that the mineral is uniaxial and optically negative, with index of refraction ranging from slightly less than to slightly more than 1.71. In the oxidizing blowpipe flame these crystals fuse with intumescence to a brown, glassy, non-magnetic bead. These properties indicate that the mineral is idocrase (vesuvianite).

Idocrase has been found in association with serpentine as pseudo jade called californite, and also embedded in quartz at an asbestos quarry at Eden Mills, Vermont. It most commonly occurs in contact-metamorphic zones of impure limestones in association with garnet, diopside and wollastonite.

Two thin sections of white rock were studied. One was cut across the contact with serpentinite, and one was made from a medium-grained specimen taken near the centre of a dyke. Medium-grained material has the following composition:

Plagioclase (An_{32})	30%
Pyroxene (Pigeonite?)	15%
Garnet	15%
Tremolite	10%
Biotite	10%
Fine-grained Opaque Material	10%
Chlorite	5%
Talc (Muscovite?)	5%

Plagioclase forms a fine-grained ground-mass of sutured, turbid laths. Pyroxene and tremolite are partly replaced by garnet and biotite which form subhedral grains and flakes, and by chlorite and talc(?) which are mainly interstitial. A veinlet of fresh material $1/32$ in. wide is composed of subhedral to euhedral crystals of plagioclase, garnet, anthophyllite and pyroxene.

The thin section of the contact has a very fine-grained texture which may result from alteration rather than from contact chilling (Gabrielse, 1963). Pyroxene crystals

(probably pigeonite) are almost entirely replaced by garnet and very fine-grained chlorite. Relict medium-grained crystals of plagioclase have been altered to chlorite and fine-grained white opaque (clay?) material. Garnet occurs as stringers of crystals.

Very thin veins of carbonate perpendicular to the contact penetrate up to $3/4$ in. into serpentinite. Serpentinite is very fine-grained and contains no chrysotile. A few remnant crystals (probably plagioclase) are present. Very fine-grained garnet occurs as stringers and isolated grains. It is believed that garnet causes the dark brown colour seen in "reaction rims".

Three main theories have been advanced to explain these rocks. Larsen (1928) studied corundum-oligoclase rocks (plumasites) from eight localities that are identical in megascopic characteristics and occurrence to the white rocks of Tower Peak. He concluded that they were formed by alumina-rich hydrothermal solutions. Du Toit (1918, 1928) believes such rocks are normal aplites or pegmatites that have been desilicated. Roots (1954) believes corundum-plagioclase rocks in ultrabasics in the Aiken Lake map-area are altered dykes. Gabrielse (1963), studied rocks almost identical in composition and environment to those at Tower Peak. He noted the similarity between white rocks and Sylvester greenstones, and concluded that they were intruded as dykes of gabbroic rock. He called them rodingites.

The writer suggests that white rocks (or rodingites) were emplaced at Tower Peak as dykes before serpentinization. Subsequent deformation of ultrabasics after serpentinization broke the dykes apart, and in serpentinized areas serpentinite flowed around sections of dyke, much like boudinage. Where serpentinization is incomplete the dykes are strongly fractured, but boudinage structure is absent.

CHAPTER III MAGNETIC PROPERTIES

General Statement

The Geological Survey of Canada published an aero-magnetic map of the Tower Peak area in 1961. Ground magnetic data were gathered by the writer and associates in June, 1964. A fluxgate magnetometer was used for both surveys.

J. H. Low (1957) and H. K. Conn (1957) have attempted to correlate local high magnetic anomalies in serpentine with development of asbestos fibre. They found that some magnetic highs occurred over asbestos, while other highs were not associated with asbestos. Some asbestos deposits had no magnetic expression.

There may be several reasons why all asbestos deposits are not expressed by high magnetic anomalies:

1. Two kinds of magnetite may be present, in variable proportions, that might have very different histories.

Magnetite that crystallized from an ultrabasic magma is apt to be erratically distributed particularly under conditions of magmatic differentiation. Such magnetite might be expected to produce a magnetic high.

2. Iron released during the process of serpentinization and the formation of asbestos will appear as polar magnetite. At time of formation such magnetite would be expressed by a magnetic high. However, if subsequently the rock mass were reoriented or the earth's magnetic field changed direction such polar magnetite might or might not be aligned with the earth's field.

Although magnetic topography will not in all instances point to asbestos deposits, it may indicate the formation and shape of ultrabasic rocks. Further, it may indicate fault displacements or shear zones that are likely places for asbestos. In the Tower Peak exploration program both airborne and ground magnetic surveys were used to outline the probable extent of ultrabasic rocks.

Airborne Magnetic Data

Airborne magnetic data were obtained with a Gulf Mk. III magnetometer, which has a sensitivity of one gamma. Data for the general Tower Peak region is on Plate II. Plate IV is an overlay enlarged to 1 in. = 1000 ft., the scale of the geologic map.

This airborne anomaly is fairly smooth and continuous, and reflects in a general way the distribution of ultrabasic rock. Total magnetic relief at Tower Peak is about 2000 gammas and is probably caused by a near-surface body rather than a deep basement structure.

Irregularities of magnetic intensity probably represent inhomogeneous distribution of magnetite. There are no irregularities of magnetic contours that might suggest lateral fault displacement of the magnetic source.

Ground Magnetic Data

Ground magnetic data was obtained using a Sharpe MF-1 Fluxgate Magnetometer, which has a maximum sensitivity of 20 gammas per scale division and a maximum range of 100,000 gammas. Weight (including 12 size "C" flashlight batteries) is nine pounds. Figure 14 is a photograph of this instrument being read at a survey peg.

Readings were taken at 100-ft. intervals along lines spaced 400 ft. apart. Lines were run with tape and compass from a chained base-line so that any closing error from each survey loop could be distributed around the loop. Base stations were read every two hours, and diurnal variation ranged up to 100 gammas. Approximately 2000 readings were made. Values obtained were plotted on maps at 200 ft. per



Fig.14 Sharpe MF-1 Fluxgate Magnetometer

inch, and contoured. A ground magnetic contour map at a scale of 1000 ft. per inch was then prepared (see Plate V).

Interpretation of Magnetic Data

Ground and airborne magnetic anomalies agree in major characteristics. Readings from both surveys are highest near the centre of the maps, fall off quickly to the south, and divide into a two-pronged area of high magnetic field to the north. The airborne anomaly is about 2000 gammas above background, and the ground anomaly is as much as 8000 gammas above background. This four-fold increase in magnetic

intensity is caused by a near-surface source; hence, the source is magnetite in the ultrabasic body.

Ground magnetometer readings over slate outcrops were never greater than 1000 gammas, and usually were less; hence, it was assumed that all areas having a magnetic intensity of 1000 gammas or less were underlain by slate.

Peaks and ridges of very high magnetic intensity, i.e. over 4000 gammas, that appear on the ground magnetic map, are believed to indicate unusually thick sections of ultrabasic rock rather than local high magnetite content. However, the highest magnetic anomaly occurs over the area where the best chrysotile was found, and very low readings were obtained in the northeast where serpentization is not complete. For this reason it is impossible to derive an exact correlation between thickness of ultrabasics and magnetic intensity.

Two things are worth noting about the ground magnetometer map (Plate V). First, magnetic contours coincide in a general way with topographic contours. For example, the 1000 gamma contour corresponds generally to the topography of Fish Creek valley. Second, a large number of small isolated areas of high and low magnetic field appear on the map. Readings often varied up to 500 gammas within 20 ft. of a survey station in a magnetically high area. Survey results were often difficult to duplicate even though readings at accurately located base stations checked well.

Plate VII shows three air and ground magnetic profiles taken in an east-west direction at 3500-ft. intervals, and also a geological interpretation that would explain both magnetic characteristics and known geological features. The ultrabasic body is interpreted as a concordant intrusion from 500 to 1000 ft. thick that dips gently to the northeast. Magnetic "valleys" in the profiles occur over places where the ultrabasic sill has been thinned or completely bisected by erosion.

CHAPTER IV GEOLOGIC HISTORY

Three main theories have been advanced to explain mode of emplacement of ultrabasic rocks. In the first, molten material near the Mohorovičić discontinuity crystallizes at depth, and ultrabasic material is concentrated by fractional crystallization and separated by filter pressing. This material rises as a crystal mush lubricated by "pore fluids" through zones of weakness in the crust generated by folding and/or fracturing. Such bodies are generally believed to be emplaced in geosynclines during early stages of tectonic activity. Being emplaced in a relatively cold state, they cause little thermal metamorphism of country rocks.

The second theory is that ultrabasic magma formed at great depth intrudes the upper crust. Such ultrabasic magma that begins to crystallize at about 1500°C, would cause strong thermal metamorphism. However, metamorphic aureoles are small because very little volatile material escapes from the ultrabasic during crystallization. Mineralogical assemblages in contact rocks are those characteristic of high temperature metamorphism. Such ultrabasic bodies usually show mineralogic zoning due to fractional crystallization.

Some serpentinites are formed by hydrothermal alteration of dolomite, magnesium-rich skarn, or amphibolite-gneiss. Country rocks grade into serpentine in which original structures are preserved.

The emplacement of ultrabasics at Tower Peak is explained best by the first theory. Little or no thermal metamorphic changes occur in the country rocks. Country rocks are highly deformed, indicating extreme stress and movement under pressure. No xenoliths or skialiths were observed in the ultrabasic body. Since white-rock dykes cut ultrabasics but not sediments, ultrabasics moved in a solid state after white-rock dykes were emplaced. No mineralogic zoning was found in the ultrabasics, indicating that they did not crystalize in their present position. Many pyroxene grains in the thin section of fresh ultrabasic show undulatory extinction, indicating stress.

The ultrabasics may have been emplaced before serpentinitization commenced. Serpentinitization is more intense near contacts, indicating that it is due to hydrothermal solutions from an external source. A plausible source is the Cretaceous intrusions which flank the body (the ultrabasics are probably Mississippian in age). Deformation has occurred since serpentinitization, but it is believed that little if any movement of the ultrabasic body occurred during this deformation.

The following table summarizes the order of geologic events that took place in the Tower Peak area. Most of the information was obtained from the Geological Survey of Canada.

AGE	EVENT
Pleistocene	- glaciation, deposition of till in valleys.
Jurassic and/or Cretaceous Orogeny	- some antigorite is altered to magnesite and quartz to cause wall-rock alteration. - intense folding and uplift causes slickensides in serpentinite and breaks up white rock dykes. - chrysotile is developed along open joints. - ultrabasics are serpentinitized by hydrothermal solutions from intrusions. - emplacement of "granitic" intrusions.
Upper Mississippian	- emplacement of ultrabasics as a relatively cool crystal mush.
Middle Mississippian Orogeny	- sediments deposited during Upper Devonian and Lower Mississippian are highly deformed, slates are mylonitized.
Upper Devonian and/or Lower Mississippian	- greenstones are emplaced as volcanic flows, in places intercalated with slates. - slates are deposited on top of a thick sequence of clastic sediments.

CHAPTER V CONCLUSIONS

1. The Tower Peak ultrabasic body reached its present position as a low-temperature crystal mush. Intrusion was concordant between Lower Mississippian slate and greenstone, and occurred during Upper Mississippian time. The body was serpentinized during Cretaceous time by hydrothermal solutions originating in "granitic" intrusions.

2. Alteration of wall/rocks is of two main types. Magnesite has replaced greenstone close to contacts, and quartz veins fill fractures in slate and greenstone. Quartz and magnesite were derived from antigorite, which was altered by hydrothermal solutions containing carbon dioxide.

3. White rocks were dykes of unknown original composition which were emplaced before serpentinization but after solidification of ultrabasics. They were partly altered to a garnet-chlorite-oligoclase assemblage, perhaps during serpentinization.

4. Very little chrysotile asbestos developed because hydrothermal solutions were not available in sufficient quantities and/or because fracturing was not extensive. Serpentinization is not complete. The nearest surface outcrop of "granite" is eight miles northwest of Tower Peak. Serpentinization may

have occurred in a high pressure environment; if so, open fractures would not be numerous.

5. Magnetometer anomalies are caused by magnetite in the ultrabasics. Anomalies are generally highest over serpentized ultrabasics, so magnetic poles were aligned  roughly parallel to the earth's present field during serpentization.

6. The Tower Peak ultrabasic body may correlate with the ultrabasic body at Cassiar, B.C. Both are associated with similar strata, and both appear to have similar modes of emplacement.

BIBLIOGRAPHY

- Berry, L. G. and Mason, B. (1959): Mineralogy; W. H. Freeman and Company, San Francisco.
- Bloxam, T. W. (1954): Rodingite from the Girvan-Ballantrae Complex, Ayrshire; Mineralogic Magazine, Vol. 30, No. 227, pp. 525-528
- Campbell, R. B.: Personal Communication, 1965.
- Canada Year Book, 1962; Dominion Bureau of Statistics, Ottawa.
- Collett, L. S.: Personal Communication, 1965.
- Conn, H. K. (1957): Magnetic Prospecting for Asbestos Deposits; Methods and Case Histories in Mining Geophysics; CIMM Congress Volume, pp. 135-140.
- Dobrin, M. B. (1960): Introduction to Geophysical Prospecting; Sec. Edit., McGraw-Hill Book Company Inc., New York.
- Ducommun, K. A. (1951): The Airborne Magnetometer and an Application in the Arnprior-Ottawa Area by the G.S.C., B. Sc. Thesis, U. B. C.
- Du Toit, A. L. (1918): Plumosite and Titaniferous Magnetite Rocks from Natal; Trans. Geol. Soc. South Africa, Vol. 21, pp. 53-73.
- ... (1928): The Origin of Corundum Aplite; Ec. Geol. Vol. 23, pp. 806-809.
- Gabrielse, H. (1960): The Genesis of Chrysotile Asbestos in the Cassiar Asbestos Deposit, Northern British Columbia; Ec. Geol. Vol. 55, pp. 327-337.
- ... (1963): McDame Map-Area, Cassiar District, British Columbia, G. S. C. Memoir No. 319.
- G. S. C. Preliminary Series, Map No. 7-1960: Quiet Lake, Yukon Territory.
- G. S. C. Aeromagnetic Map No. 1373 G: Mount St. Cyr. Yukon Territory.

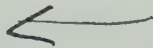
- Gifford, R. G.: Personal Communication, 1964.
- Green, L. H.: Personal Communication, 1965.
- Hood, P. J. (1964): The Ground Fluxgate Magnetometer - A New Versatile Prospecting Tool; reprinted from Canadian Mining Journal.
- Kerr, J. (1964): Geology of the Sproat Mountain Ultrabasic Intrusion; B. A. Sc. Thesis, U. B. C.
- Kerr, P. F. (1959): Optical Mineralogy; McGraw-Hill Book Company Ltd., New York.
- Kindle, E. D. (1946): Geological Reconnaissance along the Canol Road, from Teslin River to Macmillan Pass, Yukon; G. S. C. Paper No. 45-21, Sec. Edit.
- Larsen, E. S. (1928): A Hydrothermal Origin of Corundum and Albitite; Ec. Geol. Vol. 23, pp. 398-433.
- Low, J. H. (1957): Magnetic Prospecting Methods in Asbestos Exploration; Methods and Case Histories in Mining Geophysics, CIMM Congress Volume, pp. 122-134.
- Nassichuk, W. W. (1960): The Ultramafic Rocks of Northern British Columbia, Yukon, and Southeastern Alaska, B. Sc. Thesis, U. B. C.
- Noble, J. A. and Taylor, H. P. (1960): Correlation of the Ultramafic Complexes of Southeastern Alaska with those of other parts of North America and the World; Twenty-First Session of the International Geological Congress, Part X111, pp. 188-197.
- Pough, F. H. (1960): A Field Guide to Rocks and Minerals; Third Edit., The Riverside Press, Cambridge.
- Roddick, J. A.: Personal Communication, 1965.
- Roots, E. F. (1954): Geology and Mineral Deposits of Aiken Lake Map-Area, British Columbia; G. S. C. Memoir No. 274.
- Wheeler, J. O.: Personal Communication, 1965.
- Williams, H., Turner, F. S. and Gilbert, C.M. (1954): Petrography; W. H. Freeman and Company, San Francisco.

APPENDIX I

THE FLUXGATE MAGNETOMETER

The fluxgate magnetometer is a lightweight, accurate, versatile instrument which rapidly measures intensity of a magnetic field. It can be connected to a continuous recorder for airborne surveys. It was developed as a submarine detector during World War II.

Figure 15, page 41, is a schematic diagram of a magnetic sensor. The cores are ferromagnetic elements of such high permeability that the earth's field can induce magnetization that is a substantial portion of its saturation value. Alternating current of about 2000 c.p.s. is fed through the primary coils such that the cores are magnetized in opposite directions at all times. This induces currents in the secondary coils which are opposite in direction but equal to each other in magnitude when no external magnetic field is parallel to the axes of the cores. When an external field (such as the earth's) is applied, it will add to induced field in one



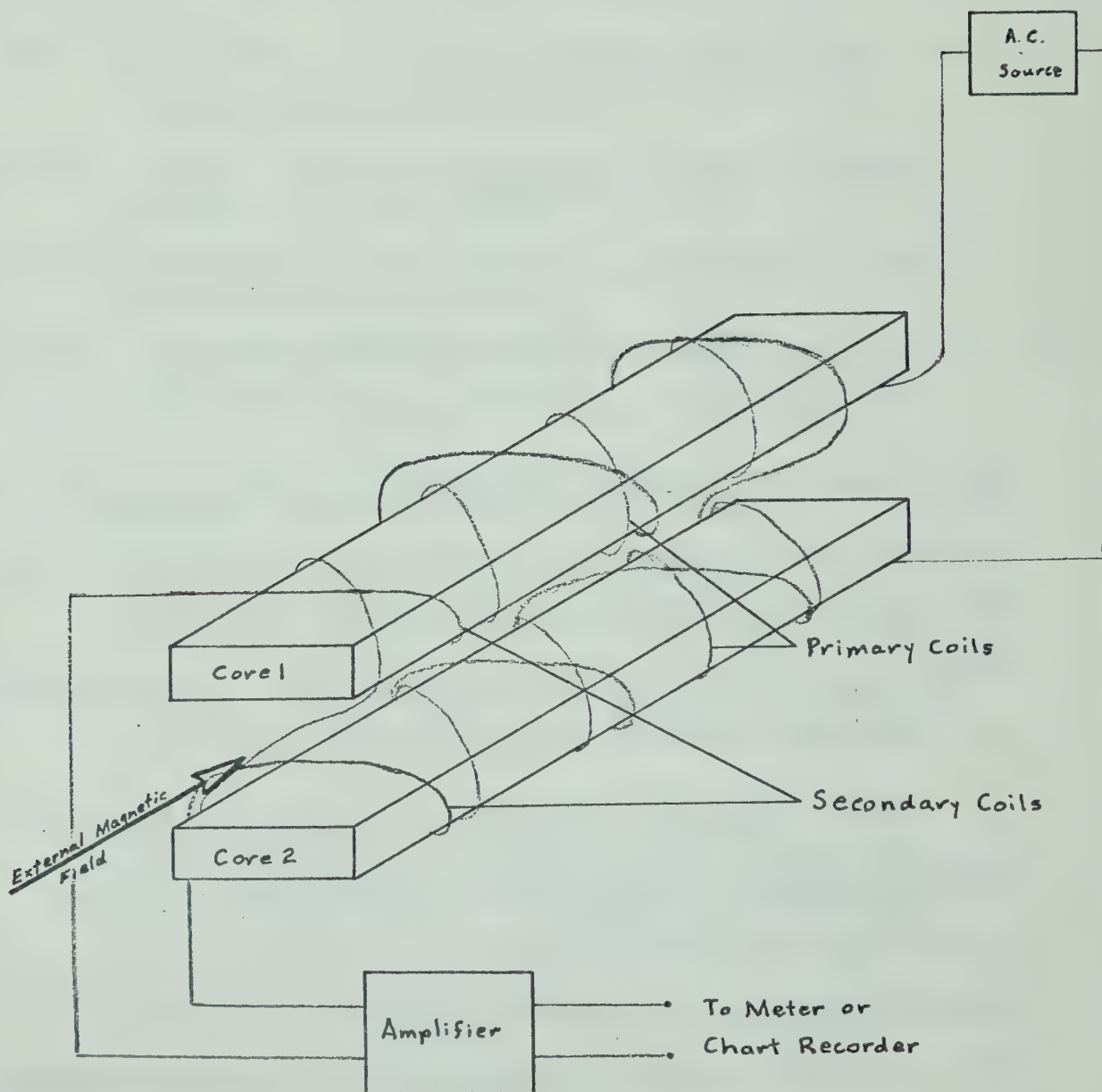


Fig. 15 Schematic Diagram of Fluxgate Magnetometer Sensor

core and subtract from induced field in the other. Hence currents of different magnitudes are induced in the secondary coils; this difference forms an alternating current which is proportional to the strength of the external field. The net induced current is amplified and used to activate a meter or a pen on a continuous recorder.

Total field is measured in airborne instruments. The magnetic sensor is mounted on gimbals and oriented parallel to the earth's field by servo motors. An accuracy of one gamma, or about one fifty thousandth of the earth's field, is easily obtained.

On the ground, vertical component of field is commonly measured because equipment required to orient the magnetic sensor parallel to the earth's field is heavy. In Canada the total field is about 30 degrees off vertical, so if the sensor deviates from vertical by one second of arc, a one gamma error is introduced. Fluxgate magnetometers used on the ground generally measure vertical field with an accuracy of 20 gammas.

APPENDIX II

EFFECT OF CHANGE IN FLYING HEIGHT ON MAGNETIC DATA

Airborne geophysical surveys in mountainous country are subject to errors arising from deviations from nominal flying height. Nominal flying height is the distance from aircraft to ground which the pilot attempts to maintain during the survey. Flying height above ground is measured by a radio range finder which records data continuously. Plates VI show that flying height deviated from its nominal value of 1000 ft. by minus 200 ft. to plus 1000 ft. in the Tower Peak area.

Changes in flying height affect magnetic data because magnetic field due to an anomalous body decreases rapidly as distance from the body increases. Rate of change of magnetic field with vertical distance for a thin horizontal magnetic sheet is computed as follows:

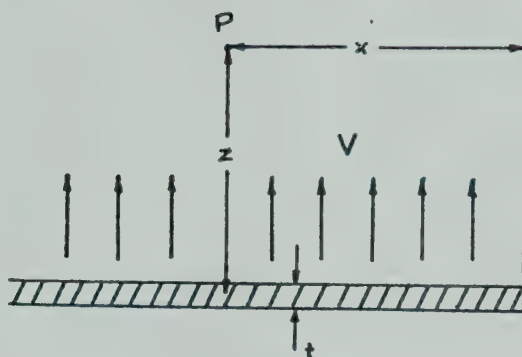


Fig. 16 Calculation of $\frac{\partial V}{\partial z}$ for Thin Horizontal Magnetic Sheet

$$V = It \frac{2x}{(x^2 + z^2)} \dots (1)$$

where V = Vertical component of anomalous magnetic field

I = intensity of magnetization
(susceptibility times earth's magnetic field strength)

t = thickness of horizontal sheet

x = horizontal distance from point of measurement to edge of sheet

z = vertical distance from point of measurement to middle of sheet

Differentiating (1) with respect to z yields

$$\frac{\partial V}{\partial z} = - \frac{4Itxz}{(x^2 + z^2)^2} \dots (2)$$

When $x = 0$, $V = 0$ and $\frac{\partial V}{\partial z} = 0$. When the point of measurement is over the sheet, however, $\frac{\partial V}{\partial z}$ will decrease approximately as $\frac{1}{z^3}$ for a given x .

Plate No.

- | | |
|-----|--|
| I | Geol. Surv. Canada "Quiet Lake Geology" |
| II | Geol. Surv. Canada "Mt. St. Cyr Airborne Magnetometer" |
| III | Tower Peak Topography and Geology |
| IV | Tower Peak Airborne Magnetometer |
| V | Tower Peak Ground Magnetometer |
| VI | Geol. Surv. Canada Flying Height Profiles |
| VII | Geologic Sections and Magnetometer Profiles |

99999

Pam:551: (*430)

HA

of
Pe

Borr

Pam:551: (*430)
HAM

ies of an ultrabasic body at
y John M. Hamilton.
sh Columbia, Dept. of Geology,
pe, 24 x 38 cm.
gree. Result of field work
id.

AKQ-2024

#99999

99999

Pam:551: (*430)
HAM

11 sheets

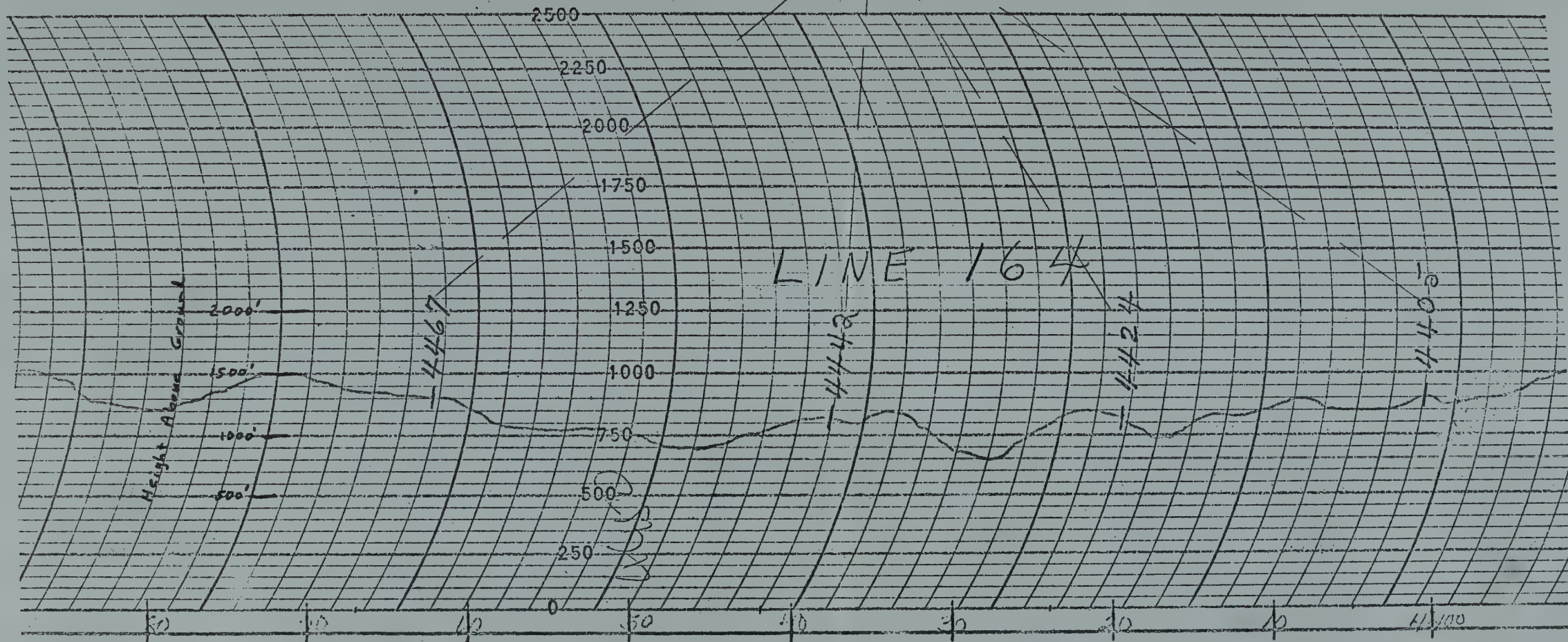
HAMILTON, John M.
Geology and magnetic properties
of an ultrabasic body at Tower
Peak,

Boreal Institute for Northern
Studies Library
CW 401 Bio Sci Bldg
The University of Alberta
Edmonton, AB Canada T6G 2E9

These numbers correspond to green numbers on Plate II

JS CO. INDIANAPOLIS, IND., U. S. A.

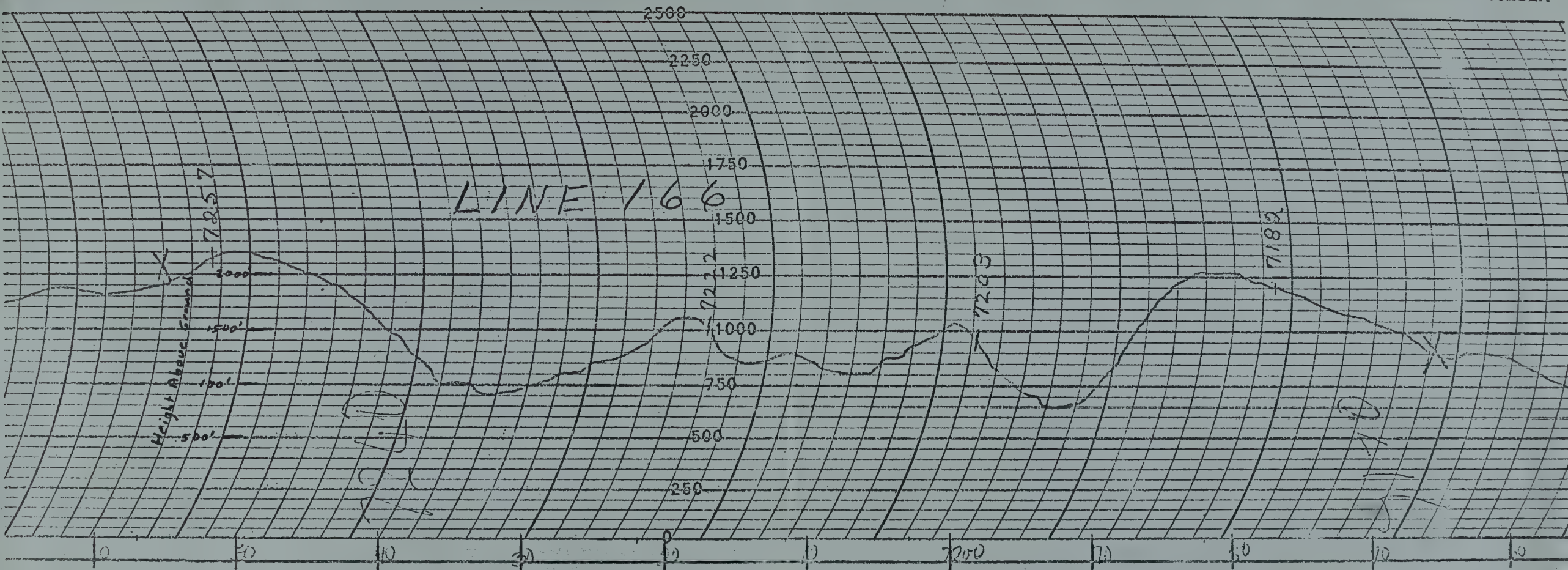
E.S.

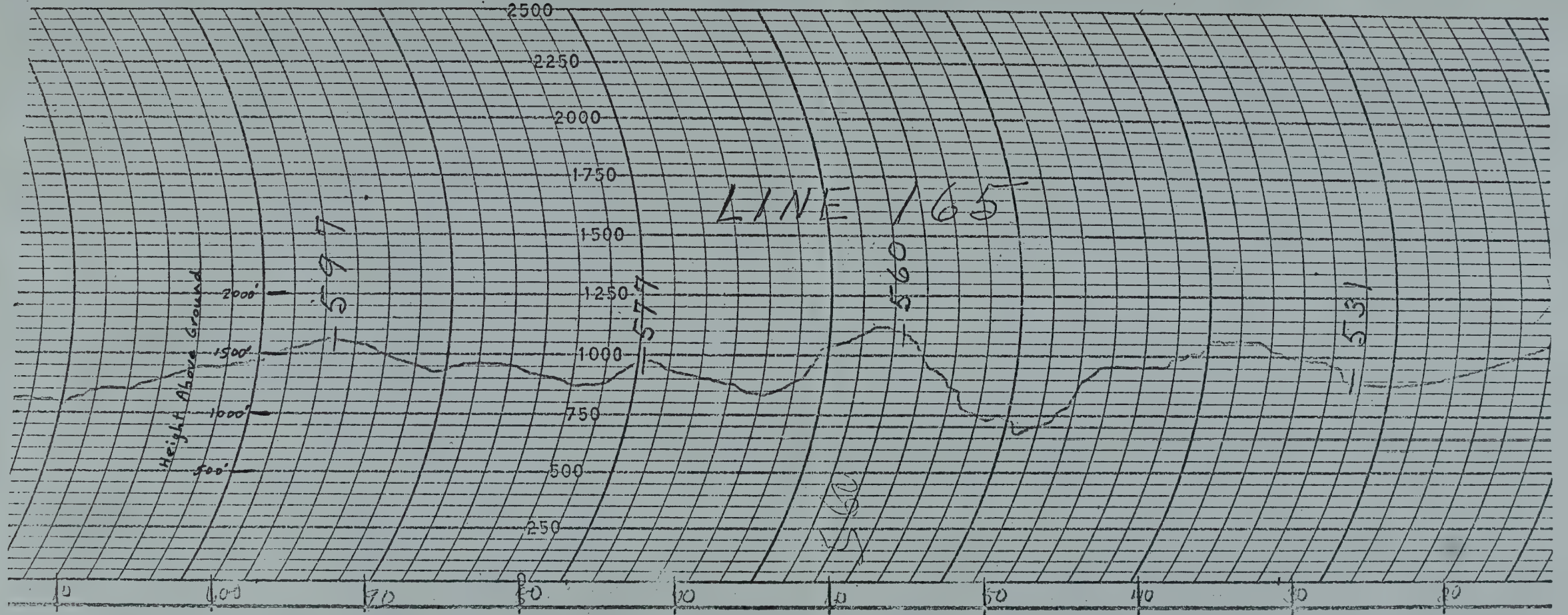


THE ESTERLINE-ANGUS CO.

INDIANAPOLIS, IND., U. S. A.

CHART NO. 43232X





LEGEND

Map-units 6d, 3a, appear on
Map 8-1960, "Finlayson Lake" only

QUATERNARY

Unconsolidated glacial and alluvial deposits

TERTIARY

Dark brown and black basalt flows

PALEOCENE

Shale, sandstone, and conglomerate

JURASSIC AND/OR CRETACEOUS

Medium- to coarse-grained, biotite granodiorite and
quartz monzonite, in part porphyritic; minor diorite,
gabbro, and gneiss

Current-bedded, ripple-marked, dark grey limestone;
minor dark grey and brown argillite, and dolomite

MISSISSIPPIAN (?) OR EARLIER

Heterogeneous, shattered hornblende syenite,
associated with unit 6

6a, partly altered green volcanic rocks, greenstone,
meta-diorite; minor serpentine and amphibolite;
6b, green and maroon breccias, tuffs, and flows;
6c, meta-diorite, slate, chert, and greywacke;
6d, buff, rusty, and pale green felsic breccias and
tuffs; minor chert and brown crinoidal limestone;
6e, massive grey and cream limestone

Brown and black-weathering, siliceous slate and shale,
thin-bedded varicoloured cherts with shaly partings,
speckled grey and brownish grey greywacke; minor
chert pebble conglomerate

SILURIAN AND DEVONIAN

4 Grey and buff-weathering, thick-bedded dolomite with
local lenses of chert; buff to reddish weathering, well-
bedded, dark grey dolomite, and sandy and silty
dolomites; buff, grey and white, lichen-covered
quartzite

platy black limestone, grey and pink
minor volcanic breccia

PRELIMINARY SERIES

GEOLOGICAL SURVEY
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

61°00'

134°00' PUBLISHED, 1960

45°

MAP 7-1960
GEOLOGY

YUKON TERRITORY

Scale: One Inch = Four Miles = 4 Miles

4 2 0

COPIES OF THIS MAP MAY BE OBTAINED FROM THE
DIRECTOR, GEOLOGICAL SURVEY OF CANADA, OTTAWA

INDEX MAP

POLAR
PAM
1692

POLARPAM



DESCRIPTIVE NOTES

The map-area is accessible during the summer months by motor vehicle on the Canol Road as far as Pelly River, by small boat on Big Salmon, Pelly, and Nisutlin rivers, by horse along the major valleys, and by float-equipped aircraft. The Hoole Canyon on Pelly River requires a portage.

Ice covered all or most of the area during the Pleistocene. It moved west and northwest along the major valleys, controlled strongly by topography in the Pelly Mountains.

The quartzites (1a) exposed near the gold property west of Ketza River, and south of White Creek are the oldest unmetamorphosed rocks in the Pelly Mountains. They are at least 1,000 feet thick and are overlain by a few hundred feet of phyllite and slate (1b) containing trilobite fragments. These in turn are overlain by limestone (1c) with Lower Cambrian archeocyathids. The Lower Cambrian limestone, and probable correlatives west of Lapie Lakes are overlain by a extensive unit of phyllite (2) of unknown thickness. Intrusive and extrusive bodies of greenstone occur within the phyllite. Metamorphism to phyllite (2) of the pre-existing shales southwest of the head of Ram Creek was prevented by previous alteration to hornfels.

Unit 2 is separated from unit 4 in several places by black slates, siltstones, and, locally, volcanic breccia (3) totalling probably less than 700 feet in thickness. Graptolites collected from beds in this unit range in age from Lower Ordovician to Silurian. The volcanic breccia (3a) overlying the graptolitic siltstone is characterized by turquoise-green fragments.

Unit 4 consists of three members. Its total thickness is 3,500 feet near McConnell Peak, 1,000 feet near the head of Ram Creek, and perhaps as much as 5,000 feet near Fox Mountain. The basal member is about 2,000 feet thick, except near the head of McConnell River where it is reduced to about 25 feet at McConnell Peak where it is missing. Near Mount Hogg the basal member is composed of sandy and silty dolomites with lenses of massive, grey dolomite containing fossils of Silurian age. The basal member is restricted to fault blocks near peak 6570. The middle member consists of dolomitic sandstone and quartzite, and is about 1,000 feet thick except near the head of McConnell River and west of Seagull Creek, where it is about 300 feet thick. It commonly contains current-bedding and ripple marks. The upper member, mainly a dark grey dolomite, contains Middle Devonian fossils. It is more than 1,500 feet thick near Fox Mountain, but elsewhere is less than 1,000 feet.

Clastic sedimentary rocks and bedded chert (5) and volcanic rocks (6) lie disconformably, at different localities, on units 2, 3, and 4. Unit 5 contains possible fossil plants 8 miles northwest of Fox Mountain (outside the map-area). Felsic volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The several volcanic rocks (7) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (8) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

Unit 8 consists of felsic volcanic rocks (9) which are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (10) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (11) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (12) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (13) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (14) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (15) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (16) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (17) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (18) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (19) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (20) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (21) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

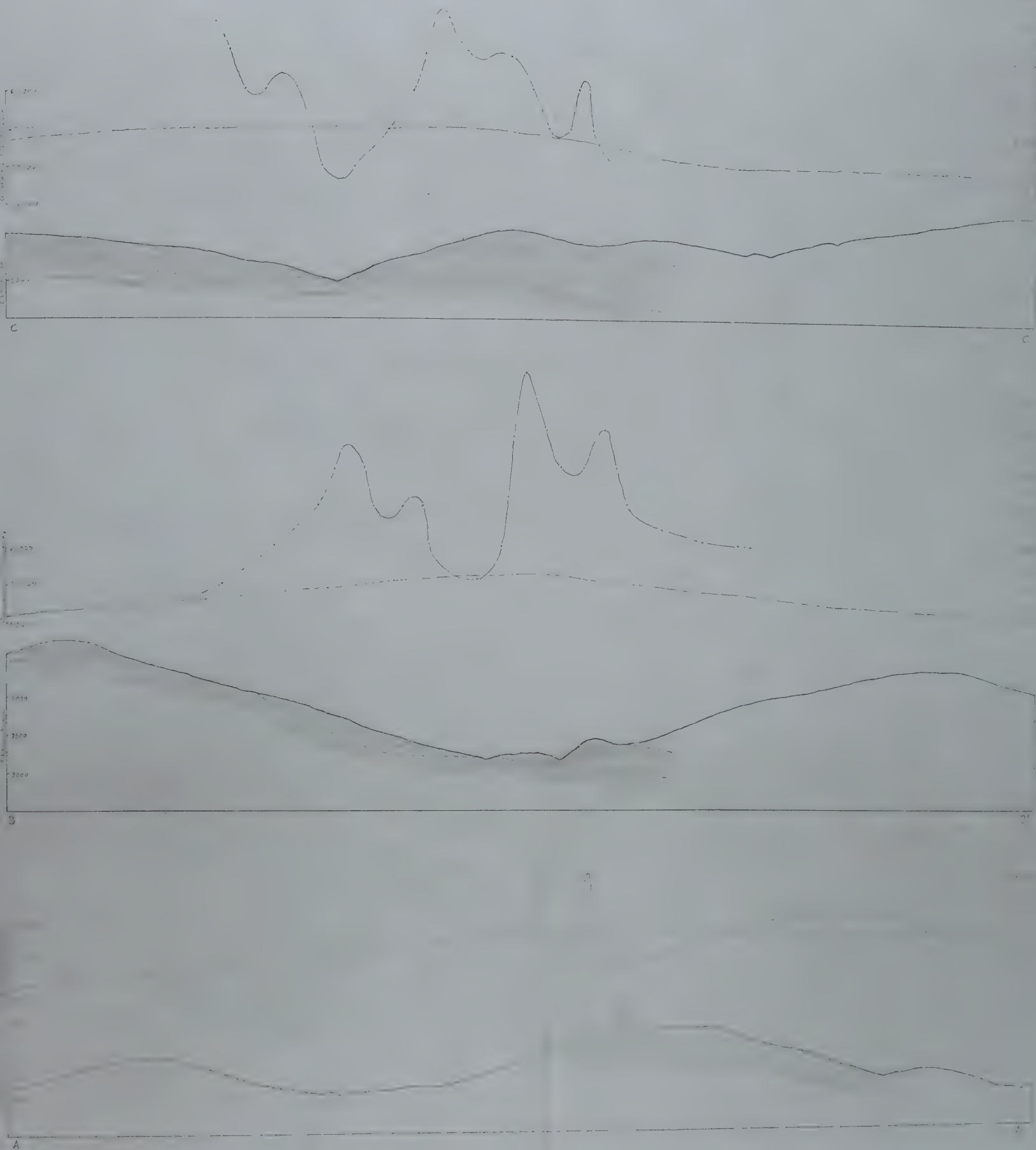
The felsic volcanic rocks (22) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (23) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (24) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

The felsic volcanic rocks (25) are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust. Most of the volcanic rocks are restricted to the region east of Seagull Creek, north of White Creek, and southwest of Porcupine thrust.

John M. Hamilton



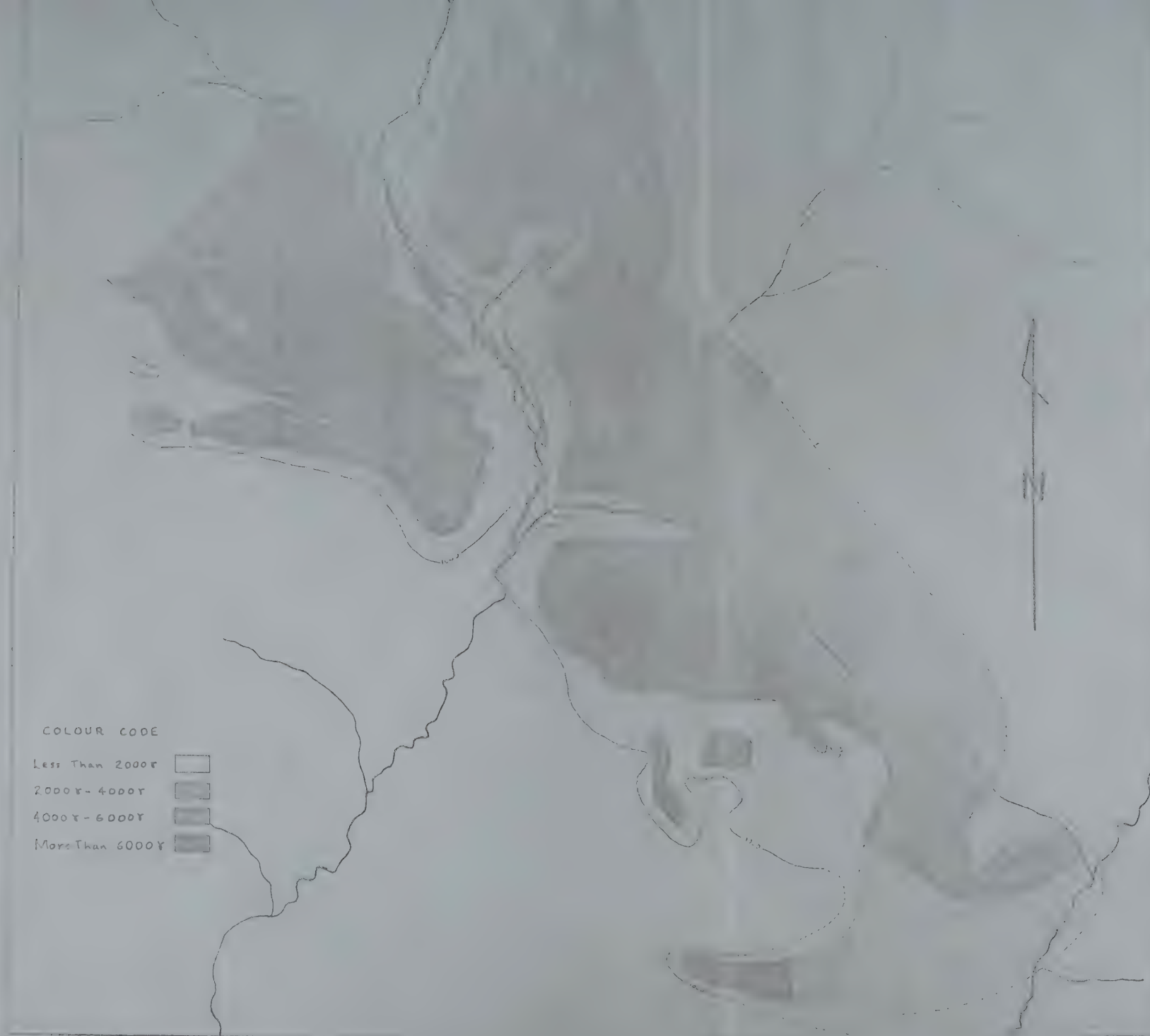
GEOLOGIC SECTIONS AND MAGNETOMETER PROFILES

ULTRABASIC 
GREENSTONE 
SLATE 

AIRBORNE MAG. PROFILE 
GROUND MAG. PROFILE 

SCALES 1 INCH = 1000 FEET

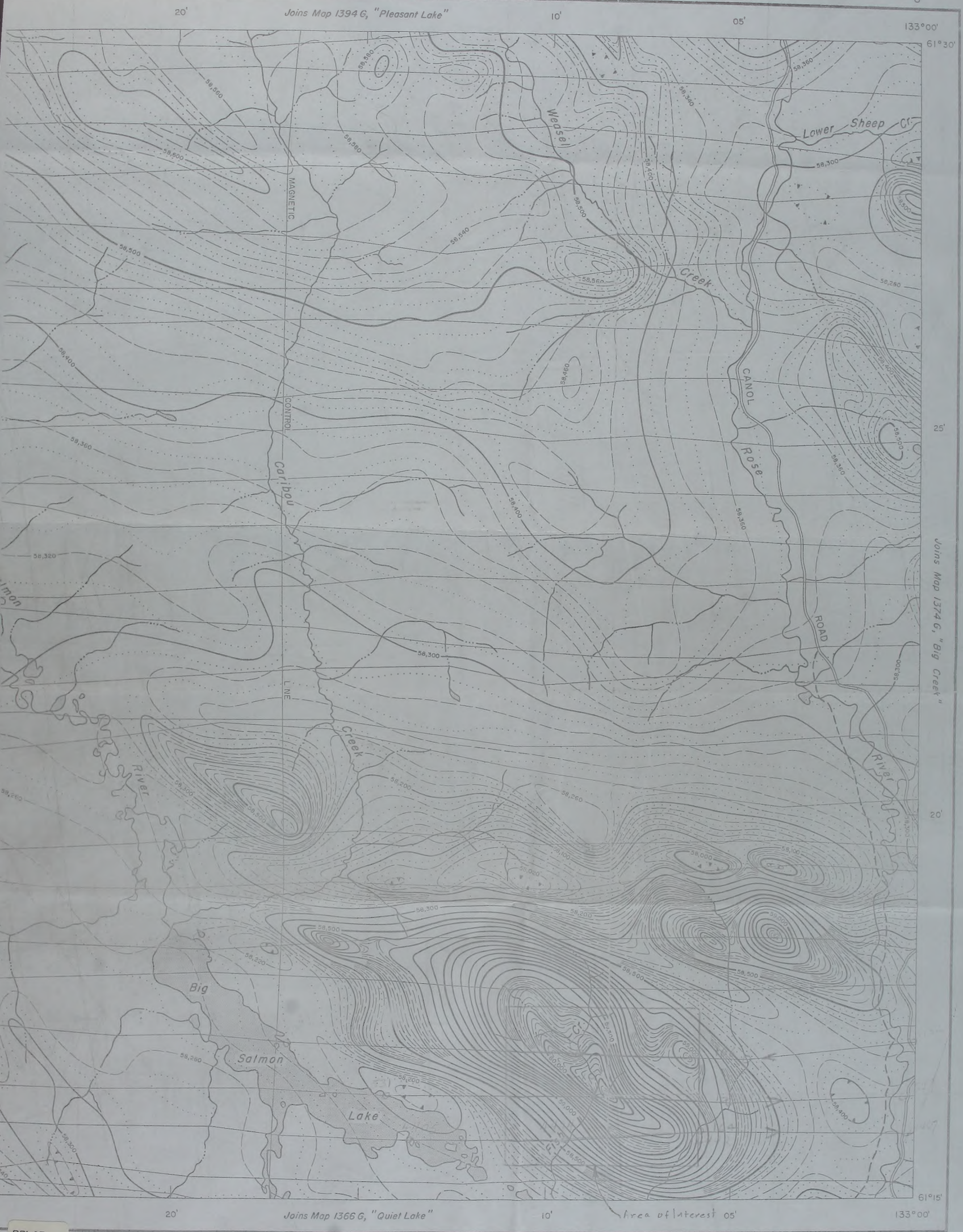
1 INCH = 2000 GAMMAS



TOWER PEAK GROUND MAGNETOMETER

CONTOUR INTERVAL EQUALS 1000 GAMMAS

SCALE 1 INCH EQUALS 1000 FEET



POLAR
PAM
1692

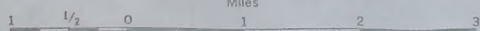
POLARPAM

SOMAGNETIC LINES (absolute total field)

500 gammas
100 gammas
20 gammas
10 gammas
Magnetic depression
Flight lines
Flight altitude: nominally 1000 feet above
ground level where terrain permitted

MAP 1373G
MOUNT ST. CYR
YUKON TERRITORY

Scale: One Inch to One Mile = $\frac{1}{63,360}$
Miles



Air photographs covering this map-area may be obtained
through the National Air Photographic Library, Topographical
Survey, Ottawa, Ontario.

Airborne Magnetic Survey, June to September, 1961,
by Aero Surveys Ltd.

No correction has been made for regional variation.

The planimetry for this map was obtained from
topographical map sheets, published by the Department
of Mines and Technical Surveys.

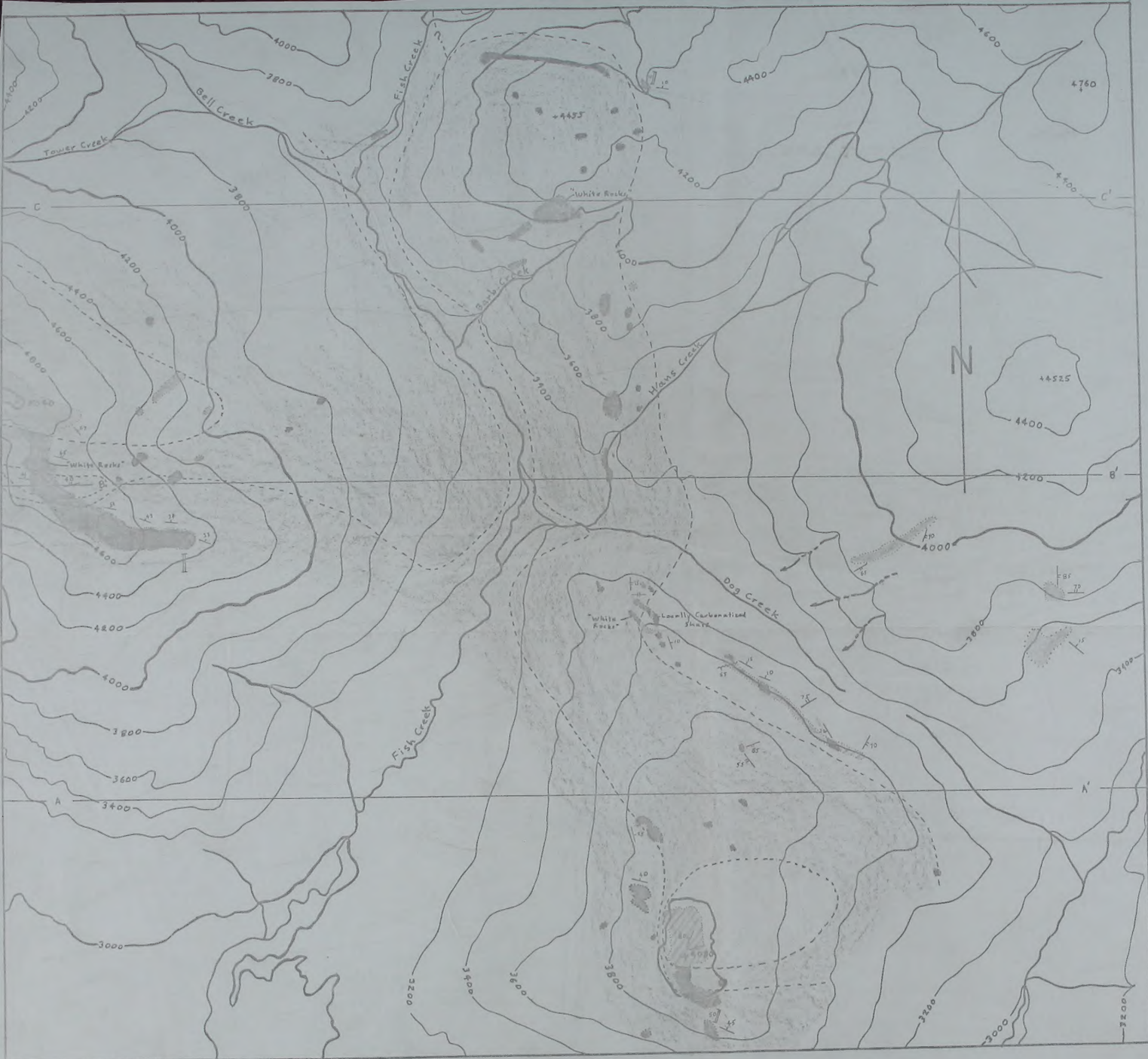
The magnetic data on this map were compiled from information
recorded along the flight lines shown. The anomalies expressed by the
magnetic contours are dependent on the variable magnetic intensities of
the underlying rocks, and may be due to conditions near, or at unknown
depths below the surface. High magnetic anomalies normally indicate
the presence of basic rocks, such as diabase, gabbro, or verpentine, which
have a relatively high iron content, but in special instances may be due,
or partly due, to concentrations of magnetic ore minerals. By means of
the magnetic anomalies, various rock bodies or structural features, such
as faults or folds, may be traced into, or across, areas of low or no out-
crops. In many instances, however, no interpretation of particular an-
omalies may be possible without further geological information.

GEOPHYSICS PAPER 1373

MOUNT ST. CYR

YUKON TERRITORY

SHEET 105 $\frac{F}{6}$



TOWER PEAK TOPOGRAPHY AND GEOLOGY

 FRESH
 SERPENTINIZED ULTRABASIC

 FRESH
 ALTERED GREENSTONE

 FRESH
 ALTERED SLATE

CONTACT, OBSERVED
 ASSUMED

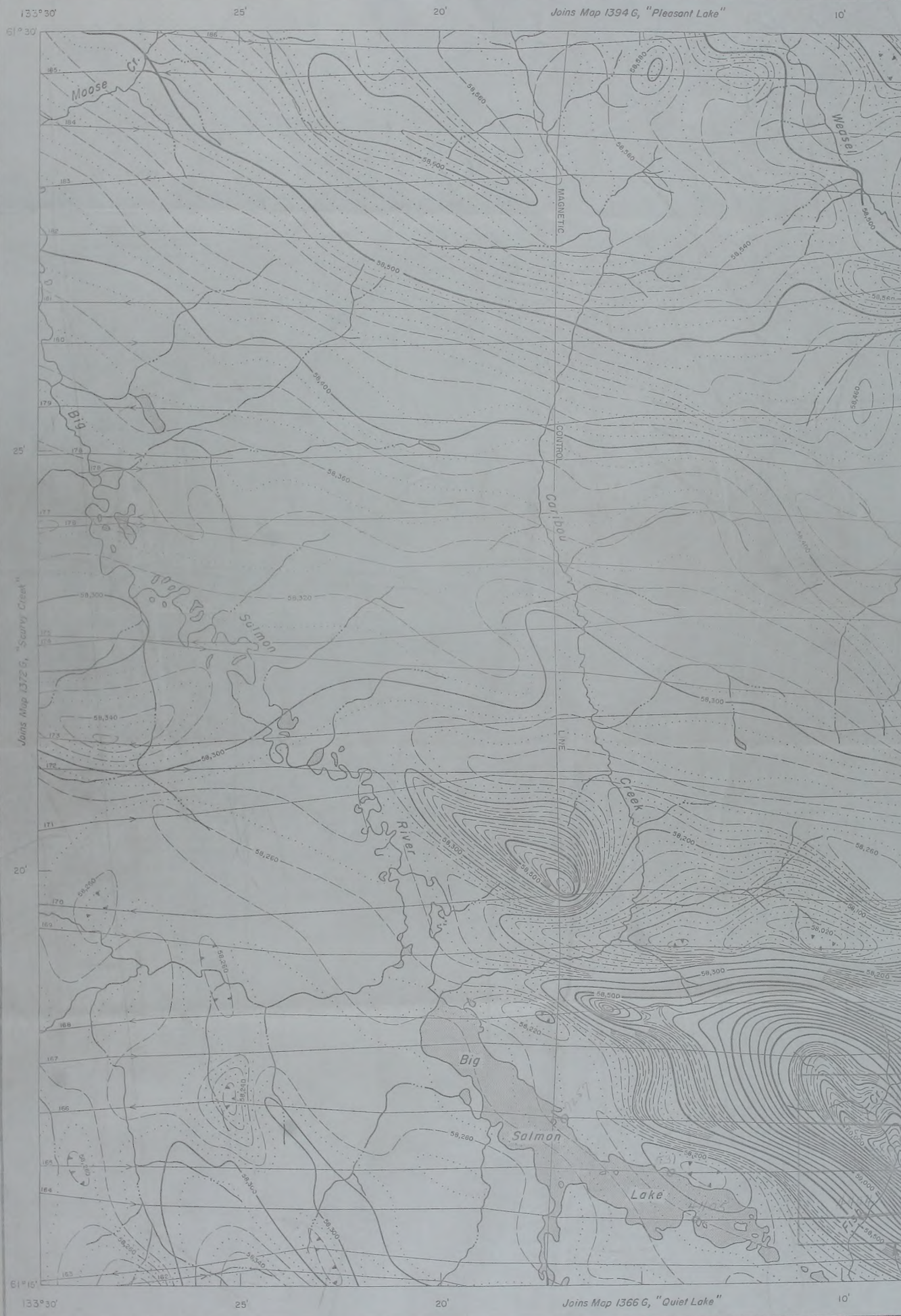
OUTCROP
 BEDDING
 JOINTS
 AXIAL CLEAVAGE
 FAULT

SCALE 1 INCH=1000 FEET
 CONTOUR INTERVAL 200 FEET



AEROMAGNETIC SERIES

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS



MAP 1373G

MOUNT ST. CYR

YUKON TERRITORY

Scale: One Inch to One Mile = $\frac{1}{63,360}$
Miles



Air photographs covering this map-area may be obtained through the National Air Photographic Library, Topographical Survey, Ottawa, Ontario.

Airborne M.
by Aero Survey

No correction

The p.
topographical
of Mines and T.

ISOMAGNETIC LINES (absolute total field)

500 gammas
100 gammas
20 gammas
10 gammas
Magnetic depression

Flight lines
Flight altitude: nominally 1000 feet above
ground level where terrain permitted

POLAR
PAM
1692

POLARPAM



BRITISH COLUMBIA
LIBRARY